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For: LITHOGRAPHIC APPARATUS AND METHOD TO DETECT CORRECT CLAMPING OF AN OBJECT

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PILLSBURY WINTHROP LLP
P.O. Box 10500
McLean, VA 22102
Telephone: (703) 905-2000
Facsimile: (703) 905-2500

Customer Number: 00909

Thomas P. Hilliard
Registration No. 40330

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The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

03075415.4

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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DEN HAAG, DEN
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Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

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Demandeur(s):
ASML Netherlands B.V.
5503 LA Veldhoven
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Lithographic Projection Apparatus

The invention relates to a lithographic projection apparatus comprising:

- at least one support structure adapted to clamp an object, the support structure and the object in use constituting a chamber, and
- supply means connected to the chamber through which supply means a gas may be supplied to the chamber.

In a lithographic projection apparatus in general, it is of paramount importance to be able to detect whether or not an object has been placed correctly on a support structure. This may for instance be the case for a wafer on a wafer table or for a reticle on the support structure for the reticle. To this end the support structure and/or the object are designed such that together, i.e. with an object placed on the support structure they constitute a closed space. In a lithographic projection apparatus working under atmospheric conditions, like the ASML Twinscan, an object is connected to a support structure, or "clamped", by evacuating the said closed space. The presence of an object on a support structure is then detected by measuring thc pressure in the space or flow from the space. When an object is present, the pressure or flow is different from the case when no object is present. This principle is, however, not feasible for a lithographic projection apparatus working under relatively high vacuum conditions such as lithographic projection apparatus using extreme ultraviolet radiation (EUV).

In a vacuum environment clamping is effected by means of electrostatic forces. Using capacitive measurements in order to detect whether an object has been placed correctly or has good contact is also not very well feasible, because of the sensitivity to electromagnetic disturbances, or due to the large variety of object materials each having different electrical properties, causing different changes in capacitances.

From the above, it is clear that a problem in the present state of the art is to assess, under vacuum conditions, whether or not an object has been placed correctly on a support structure, like e.g. a wafer on a wafer table, a so called "handler clamp" or an "exposure pin", or a mask on a chuck.

It is therefore an aim of the invention to provide a lithographic projection apparatus in which, under vacuum conditions, the correct placement of a wafer on a wafer table can be detected, or of a mask on a chuck, irrespective of any EM disturbances and irrespective of the electrical properties of the wafer or mask.

In a first embodiment the invention is characterized in that the supply means comprise a meter to measure at least one of flow velocity of the gas and pressure of the gas in order to detect whether or not said chamber is gas-tight. By pumping a (back-fill) gas in the space between an object (e.g. a wafer) and a support structure (e.g. the wafer table or the support structures mentioned above) it is possible to detect the correct placement of the wafer on the wafer table. Since, if the back-fill gas can escape from the chamber, which can be determined by measuring the pressure in and/or the flow to the space, the wafer is not correctly placed.

In a further embodiment the invention is characterized in that said meter is a flow velocity meter connected to a control unit arranged to receive a value proportional to the flow velocity and to detect whether said value reaches a predetermined value after beginning supplying said chamber with said gas. This makes it possible to detect at an early stage whether the wafer is correctly placed or not. If the wafer is correctly placed the flow velocity will drop more rapidly than will be the case when the wafer is not correctly placed. Eventually, the flow velocity will reach zero for a correctly placed wafer in a finite period of time, whereas for an incorrectly placed wafer zero will be no more than approached.

In still a further embodiment the invention is characterized in that said meter is a pressure meter connected to a control unit arranged to receive a value proportional to the pressure and to detect whether said value reaches a predetermined value after beginning supplying said chamber with said gas. Again there is a difference in the pressure increase as a function of time which makes the detection of a correct placement of the wafer possible. An arbitrary predetermined pressure (and also the predetermined final pressure) will be reached more rapidly in the case of a correct wafer placement.

For both of the last-mentioned embodiments of the invention it may be especially advantageous to have registered the typical progress of the flow velocity and/or pressure as a function of time in advance for the chamber during a correct wafer placement process.

In still a further embodiment the invention relates to a lithographic projection apparatus as described above in which the at least one support structure comprises:

- a first support structure for supporting patterning means, the patterning means serving to pattern the projection beam according to a desired pattern,

- a second support structure for holding a substrate

and the lithographic projection apparatus further comprises:

- a radiation system for providing a projection beam of radiation and
- a projection system for projecting the patterned beam onto a target portion of the substrate,

characterized in that the lithographic projection apparatus comprises at least one of the patterning means or the substrate clamped on the first support structure or the second support structure, respectively.

In still a further embodiment the invention is characterized in that the gas comprises argon. Argon is an inert gas which has the advantage that is does not easily react with its environment and is clearly distinguishable from helium used in leak detection. Gases such as, for instance, nitrogen and oxygen are other possibilities.

In still a further embodiment the invention is characterized in that the supply means are adapted to increase the pressure in the chamber from a first level to a second level during a predetermined period of time and subsequently decreasing the pressure from the second level to a third level. A temporary increase in pressure on the object will serve as a test to establish whether the clamp force is sufficient to hold the object during accelerations which will be exerted on the object during transportation in the lithographic projection apparatus.

The invention also relates to a method to detect correct clamping of an object on a support structure in a lithographic projection apparatus, the support structure and the object, in use, constituting a chamber, characterized in that the method comprises the following steps:

- supplying a gas to said chamber;
- measuring at least one of flow velocity of said gas and pressure of said gas in order to detect whether or not said chamber is gas-tight.

The invention further relates to a computer program product to be loaded by a control unit in a lithographic projection apparatus comprising a support structure to clamp an object, the support structure and the object, in use, constituting a chamber, said computer program product comprising instructions and data to allow said control unit to perform the method mentioned above.

The invention further relates to a data carrier provided with a computer program product as mentioned above.

The term "patterning means" as employed above should be broadly interpreted as referring to means that can be used to endow an incoming radiation beam with a patterned cross-section, corresponding to a pattern that is to be created in a target portion of the substrate; the term "light valve" can also be used in this context. Generally, the said pattern will correspond to a particular functional layer in a device being created in the target portion, such as an integrated circuit or other device (see below). Examples of such patterning means include:

- A mask. The concept of a mask is well known in lithography, and it includes mask types such as binary, alternating phase-shift, and attenuated phase-shift, as well as various hybrid mask types. Placement of such a mask in the radiation beam causes selective transmission (in the case of a transmissive mask) or reflection (in the case of a reflective mask) of the radiation impinging on the mask, according to the pattern on the mask. In the case of a mask, the support structurc will generally be a mask table, which ensures that the mask can be held at a desired position in the incoming radiation beam, and that it can be moved relative to the beam if so desired;
- A programmable mirror array. One example of such a device is a matrix-addressable surface having a viscoelastic control layer and a reflective surface. The basic principle behind such an apparatus is that (for example) addressed areas of the reflective surface reflect incident light as diffracted light, whereas unaddressed areas reflect incident light as undiffracted light. Using an appropriate filter, the said undiffracted light can be filtered out of the reflected beam, leaving only the diffracted light behind; in this manner, the beam becomes patterned according to the addressing pattern of the matrix-addressablc surface. An alternative embodiment of a programmable mirror array employs a matrix arrangement of tiny mirrors, each of which can be individually tilted about an axis by applying a suitable localized electric field, or by employing piezoelectric actuation means. Once again, the mirrors are matrix-addressable, such that addressed mirrors will reflect an incoming radiation beam in a different direction to unaddressed mirrors; in this manner, the reflected beam is patterned according to the addressing pattern of the matrix-addressable mirrors. The required matrix addressing can be performed using suitable electronic means. In both of the situations described hereabove, the patterning means can comprise one or more programmable mirror arrays. More information on mirror arrays as here referred to can be gleaned, for example, from United States Patents US 5,296,891 and US 5,523,193,

and PCT patent applications WO 98/38597 and WO 98/33096, which are incorporated herein by reference. In the case of a programmable mirror array, the said support structure may be embodied as a frame or table, for example, which may be fixed or movable as required; and

- A programmable LCD array. An example of such a construction is given in United States Patent US 5,229,872, which is incorporated herein by reference. As above, the support structure in this case may be embodied as a frame or table, for example, which may be fixed or movable as required.

For purposes of simplicity, the rest of this text may, at certain locations, specifically direct itself to examples involving a mask and mask table; however, the general principles discussed in such instances should be seen in the broader context of the patterning means as hereabove set forth.

Lithographic projection apparatus can be used, for example, in the manufacture of integrated circuits (ICs). In such a case, the patterning means may generate a circuit pattern corresponding to an individual layer of the IC, and this pattern can be imaged onto a target portion (e.g. comprising one or more dies) on a substrate (silicon wafer) that has been coated with a layer of radiation-sensitive material (resist). In general, a single wafer will contain a whole network of adjacent target portions that are successively irradiated via the projection system, one at a time. In current apparatus, employing patterning by a mask on a mask table, a distinction can be made between two different types of machine. In one type of lithographic projection apparatus, each target portion is irradiated by exposing the entire mask pattern onto the target portion in one go; such an apparatus is commonly referred to as a wafer stepper or step-and-repeat apparatus. In an alternative apparatus — commonly referred to as a step-and-scan apparatus — each target portion is irradiated by progressively scanning the mask pattern under the projection beam in a given reference direction (the "scanning" direction) while synchronously scanning the substrate table parallel or anti-parallel to this direction; since, in general, the projection system will have a magnification factor M (generally < 1), the speed V at which the substrate table is scanned will be a factor M times that at which the mask table is scanned. More information with regard to lithographic devices as here described can be gleaned, for example, from US 6,046,792, incorporated herein by reference.

In a manufacturing process using a lithographic projection apparatus, a pattern (e.g. in a mask) is imaged onto a substrate that is at least partially covered by a layer of radiation-sensitive material (resist). Prior to this imaging step, the substrate may undergo various procedures, such as priming, resist coating and a soft bake. After exposure, the substrate may be subjected to other procedures, such as a post-exposure bake (PEB), development, a hard bake and measurement/inspection of the imaged features. This array of procedures is used as a basis to pattern an individual layer of a device, e.g. an IC. Such a patterned layer may then undergo various processes such as etching, ion-implantation (doping), metallization, oxidation, chemo-mechanical polishing, etc., all intended to finish off an individual layer. If several layers are required, then the whole procedure, or a variant thereof, will have to be repeated for each new layer. Eventually, an array of devices will be present on the substrate (wafer). These devices are then separated from one another by a technique such as dicing or sawing, whence the individual devices can be mounted on a carrier, connected to pins, etc. Further information regarding such processes can be obtained, for example, from the book "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Third Edition, by Peter van Zant, McGraw Hill Publishing Co., 1997, ISBN 0-07-067250-4, incorporated herein by reference.

For the sake of simplicity, the projection system may hereinafter be referred to as the "lens"; however, this term should be broadly interpreted as encompassing various types of projection system, including refractive optics, reflective optics, and catadioptric systems, for example. The radiation system may also include components operating according to any of these design types for directing, shaping or controlling the projection beam of radiation, and such components may also be referred to below, collectively or singularly, as a “lens”. Further, the lithographic apparatus may be of a type having two or more substrate tables (and/or two or more mask tables). In such “multiple stage” devices the additional tables may be used in parallel, or preparatory steps may be carried out on one or more tables while one or more other tables are being used for exposures. Dual stage lithographic apparatus are described, for example, in US 5,969,441 and WO 98/40791, both incorporated herein by reference.

Although specific reference may be made in this text to the use of the apparatus according to the invention in the manufacture of ICs, it should be explicitly understood that such an apparatus has many other possible applications. For example, it may be

employed in the manufacture of integrated optical systems, guidance and detection patterns for magnetic domain memories, liquid-crystal display panels, thin-film magnetic heads, etc. The skilled artisan will appreciate that, in thc context of such alternative applications, any use of the terms "reticle", "wafer" or "die" in this text should be considered as being replaced by the more general terms "mask", "substrate" and "target portion", respectively.

In the present document, the terms “radiation” and “beam” are used to encompass all types of electromagnetic radiation, including ultraviolet (UV) radiation (e.g. with a wavelength of 365, 248, 193, 157 or 126 nm) and extreme ultra-violet (EUV) radiation (c.g. having a wavelength in the range 5-20 nm), as well as particle beams, such as ion beams or electron beams.

The invention will now be explained in connection with the accompanying drawings, which are only intended to show examples and not to limit the scope of protection, and in which:

Fig. 1 is a schematic general overview of a lithographic projection apparatus ,

Fig. 2 shows a schematic setup of an embodiment of the invention,

Fig. 3 is a graph of the flow velocity versus time for the gas in the supply system,

Fig. 4 is a graph of the pressure in the supply system versus time, and

Fig. 5 illustrates a temporary increase in pressure which is used to test the effectiveness of the clamping.

Fig. 1 schematically depicts a lithographic projection apparatus 1 according to a particular embodiment of the invention. The apparatus comprises:

- a radiation system Ex, IL, for supplying a projection beam PB of radiation (e.g. EUV radiation) with a wavelcngth of 11-14 nm. In this particular case, the radiation system also comprises a radiation source LA;
- a first object table (mask table) MT provided with a mask holder for holding a mask MA (e.g. a reticle), and connected to first positioning means PM for accurately positioning the mask with respect to item PL;
- a second object table (substrate table) WT provided with a substrate holder for holding a substrate W (e.g. a resist-coated silicon wafer), and connected to second

positioning means PW for accurately positioning the substrate with respect to item PL; and

- a projection system ("lens") PL for imaging an irradiated portion of the mask MA onto a target portion C (e.g. comprising one or more dies) of the substrate W.

As here depicted, the apparatus is of a reflective type (i.e. has a reflective mask). However, in general, it may also be of a transmissive type, for example (with a transmissive mask). Alternatively, the apparatus may employ another kind of patterning means, such as a programmable mirror array of a type as referred to above.

The source LA (e.g. a laser-produced plasma or a discharge plasma EUV radiation source) produces a beam of radiation. This beam is fed into an illumination system (illuminator) IL, either directly or after having traversed conditioning means, such as a beam expander Ex, for example. The illuminator IL may comprise adjusting means AM for setting the outer and/or inner radial extent (commonly referred to as σ-outer and σ-inner, respectively) of the intensity distribution in the beam. In addition, it will generally comprise various other components, such as an integrator IN and a condenser CO. In this way, the beam PB impinging on the mask MA has a desired uniformity and intensity distribution in its cross-section.

It should be noted with regard to Fig. 1 that the source LA may be within the housing of the lithographic projection apparatus (as is often the case when the source LA is a mercury lamp, for example), but that it may also be remote from the lithographic projection apparatus, the radiation beam which it produces being led into the apparatus (e.g. with the aid of suitable directing mirrors); this latter scenario is often the case when the source LA is an excimer laser. The current invention and claims encompass both of these scenarios.

The beam PB subsequently intercepts the mask MA, which is held on a mask table MT. Having traversed the mask MA, the beam PB passes through the lens PL, which focuses the beam PB onto a target portion C of the substrate W. With the aid of the second positioning means PW (and interferometric measuring means IF), the substrate table WT can be moved accurately, e.g. so as to position different target portions C in the path of the beam PB. Similarly, the first positioning means PM can be used to accurately position the mask MA with respect to the path of the beam PB, e.g. after mechanical retrieval of the mask MA from a mask library, or during a scan. In general, movement of the object tables MT, WT will be realized with the aid of a long-

stroke module (coarse positioning) and a short-stroke module (fine positioning), which are not explicitly depicted in figure 1. However, in the case of a wafer stepper (as opposed to a step-and-scan apparatus) the mask table MT may just be connected to a short stroke actuator, or may be fixed. Mask MA and substrate W may be aligned using mask alignment marks M1, M2 and substrate alignment marks P1, P2.

The depicted apparatus can be used in two different modes:

1. In step mode, the mask table MT is kept essentially stationary, and an entire mask image is projected in one go (i.e. a single "flash") onto a target portion C. The substrate table WT is then shifted in the x and/or y directions so that a different target portion C can be irradiated by the beam PB; and

2. In scan mode, essentially the same scenario applies, except that a given target portion C is not exposed in a single "flash". Instead, the mask table MT is movable in a given direction (the so-called "scan direction", e.g. the y direction) with a speed *v*, so that the projection beam PB is caused to scan over a mask image; concurrently, the substrate table WT is simultaneously moved in the same or opposite direction at a speed $V = Mv$, in which M is the magnification of the lens PL (typically, $M = 1/4$ or 1/5). In this manner, a relatively large target portion C can be exposed, without having to compromise on resolution.

The embodiment of Fig. 2 comprises a wafer chuck 2 on which a clamp 3 is positioned. On the surface of the clamp 3 protrusions 4 are present. Spaces 7 between the protrusions are provided in the clamp 3. The spaces 7 communicate with each other. A wafer 5 is placed on the clamp 3. The assembly of the wafer chuck 2, the clamp 3 and the wafer 5 constitute a chamber comprising the spaces 7, which chamber is connected to a gas storage chamber 13 via a gas inlet 9 and a supply channel 11. A sealing portion 19, arranged to prevent gas from entering the space housing the assembly is located in between the wafer 5 and the wafer chuck 2. In the supply channel 11, a meter 15 is provided for measuring either the gas flow through the supply channel 11 or the pressure in the chamber. It is possible to change the pressure in the chamber by use of, for instance, a pump or a (reduction) valve 21 present in the supply channel 11. The pump or valve 21 are arranged to supply a so-called "back-fill gas" to the chamber. Moreover, a further valve 23 is provided in a branch of the supply channel 11 that is connected to a vacuum chamber 25. By opening the valve 23 any back-fill gas present in the chamber may be sucked away. Alternatively, the back-fill gas may be

removed by using a pump 21 that is arranged to operate in two ways: i.e. it is able to increase and decrease the pressure in the chamber. Operated in the latter way, the pump 21 will remove the back-fill gas from the chamber. An electrode 17 is provided in the wafer chuck 2 which is adapted to exert a force on the wafer 5 in the direction of the clamp 3 for attracting the wafer 5 to the clamp 3 and the wafer chuck 2. To that end, the electrode 17 is supplied with a suitable supply voltage from a voltage source 27. In practice, this electrode 17 may be split in several electrode planes. One electrode plane is located in the clamp 3 and attracts the wafer 5 to the clamp 3 and with another electrode plane, also located in the clamp 3, the clamp 3 attracts itself to the wafer chuck 2. Another electrode plane, a ground clectrode, is located in between the wafer chuck 2 and the clamp 3.

If the wafer 5 is clamped correctly by the electrodes 17 the chamber should be gas-tight.

After placing the wafer 5 on the clamp 3 either the flow or the pressure in the supply channel 11 is measured by the meter 15. This measurement is preferably carried out as a function of time. If the flow does not reach a predetermined value, which preferably should be zero, and/or the pressure does not reach a predetermined pressure, which can be the end pressure, sufficiently fast, then it may be concluded that gas is leaking between the clamp 3/sealing portion 19 and wafer 5, which may be caused by misplacing the wafer 5 on the clamp 3.

A control unit 29 is provided, connected to the voltage source 27, the meter 15, the pump 21 and the valve 23. The control unit 29 is arranged to operate these components correctly in accordancc with settings e.g. received from an operator, and to receive measurement values/operation conditions in return.

Moreover, the control unit 29 has an output to provide suitable output data to the operator, e.g. in the form of data for a printer (not shown), a monitor (not shown), etc. The control unit 29 may be implemented as a computer with suitable software, or as a controller with suitable analog and/or digital circuits. Moreover, the control unit 29 may actually comprise two or more sub-units each designed to perform one or morc tasks.

In Fig. 3 and 4 the process of detecting correct placement of the wafer 5 is further illustrated. In Fig. 3 the flow as measured by the meter 15 is plotted versus time. Two different graphs are shown. The graph labeled with an "a" shows that as time

progresses the flow approaches zero, as it should be for a correctly placed wafer 5 constituting a gas-tight chamber. In the graph labeled with a "b", on the other hand, the flow does not reach zero within a reasonable period of time indicating that there is leakage of gas from the chamber which consequently means that there probably is a placement problem.

Similar considerations as detailed hereinbefore apply to Fig. 4 in which the pressure measured in the supply channel 11 is plotted versus time. When the wafer 5 is correctly placed the pressure approaches a final pressure P as indicated by curve "c". When this final pressure is not obtained sufficiently fast (curve "d"), this again means that there may be a wafer placement problem.

Fig. 5 illustrates that in order to determine how firm the clamping between the wafer 5 and the clamp 3 is, the pressure of the gas in the chamber may, from a time t5 onwards temporarily be increased to P3, by use of pump 21. From a time t6 onwards the pressure is returned to the starting pressure (i.e. the pressure before t5). The increase in pressure (and subsequent decrease in pressure, though the latter is not strictly necessary) serves as a way to test that the wafer is clamped well and will remain on the clamp during, for instance, transportation. The test works as follows: During the increase in pressure, this quantity is closely monitored by the pressure meter 15. If the chamber is gas-tight, the meter will display the increase in pressure substantially simultaneously. If not, this indicates leakage and a wrongly placed wafer 5.

Alternatively the meter 15 may be a flow velocity meter. Some time after the pressure increase, the flow velocity must be zero when the chamber is gas-tight, indicating a correct wafer placement. Naturally, other pulse shapes than the pulse shape shown in Fig. 5 are possible.

Whilst we have described above a specific embodiment of the invention it will be appreciated that the invention may be practiced otherwise than described. The description is not intended to limit the invention. In particular, it will be appreciated that the invention may be used in either or both the mask or substrate stage of a lithographic apparatus.

Claims:

1. A lithographic projection apparatus (1) comprising:

- at least one support structure (MT; WT) adapted to clamp an object (W; MA; 5), the support structure (MT; WT) and the object (W; MA; 5) in use constituting a chamber, and
- supply means (11) connected to the chamber through which supply means (11) a gas may be supplied to the chamber,

characterized in that the supply means (11) comprise a meter (15) arranged to measure at least one of flow velocity of the gas and pressure of the gas in order to detect whether or not said chamber is gas-tight.

2. Lithographic projection apparatus (1) according to claim 1, characterized in that said meter (15) is a flow velocity meter connected to a control unit arranged to receive a value proportional to the flow velocity and to detect whether said value reaches a predetermined value after beginning supplying said chamber with said gas.

3. Lithographic projection apparatus (1) according to claim 1, characterized in that said meter (15) is a pressure meter connected to a control unit arranged to receive a value proportional to the pressure and to detect whether said value reaches a predetermined value after beginning supplying said chamber with said gas.

4. Lithographic projection apparatus (1) according to any of the preceding claims, in which the at least one support structure comprises:

- a first support structure (MT) for supporting patterning means (MA), the patterning means (MA) serving to pattern the projection beam (PB) according to a desired pattern,
- a second support structure (WT) for holding a substrate (W; 5)

and the lithographic projection apparatus further comprises:

- a radiation system for providing a projection beam (PB) of radiation and
- a projection system (PL) for projecting the patterned beam onto a target portion of the substrate (W; 5),

characterized in that the lithographic projection apparatus comprises at least one of said

patterning means (MA) or said substrate (W; 5) clamped on the first support structure (MT) or the second support structure (WT), respectively.

5. Lithographic projection apparatus (1) according to any of the preceding claims, characterized in that the gas comprises argon.

6. Lithographic projection apparatus (1) according to any of the preceding claims, characterized in that the supply means (11) are adapted to increase the pressure in the chamber from a first level to a second level during a predetermined period of time and subsequently decreasing the pressure from the second level to a third level.

7. Lithographic projection apparatus (1) according to claim 6, characterized in that the pressure levels are in between the range of 8 mBar and 12 mBar more preferably 10 mBar.

8. Lithographic projection apparatus (1) according to claim 6 or 7, characterized in that the period of time is in between the range of 1 s and 30 s.

9. Method to detect correct clamping of an object (W; MA; 5) on a support structure (MT; WT) in a lithographic projection apparatus (1), the support structure (MT; WT) and the object (W; MA; 5), in use, constituting a chamber, characterized in that the method comprises the following steps:

- supplying a gas to said chamber;
- measuring at least one of flow velocity of said gas and pressure of said gas in order to detect whether or not said chamber is gas-tight.

10. Computer program product to be loaded by a control unit in a lithographic projection apparatus (1) comprising a support structure (MT; WT) to clamp an object, the support structure (MT; WT) and the object, in use, constituting a chamber, said computer program product comprising instructions and data to allow said control unit to perform the method according to claim 11.

11. Data carrier provided with a computer program product according to claim 12.

Abstract

The invention disclosed is a lithographic projection apparatus (1) comprising a support structure (MT; WT) adapted to clamp an object (W; MA; 5). The support structure (MT; WT) and the object (W; MA; 5), when in use, constitute a chamber. Supply means (11) are connected to the chamber and through these supply means (11) a gas may be supplied to the chamber. The supply means (11) comprise a meter (15) to measure at least one of flow velocity of the gas and pressure of the gas. In this way, it can be detected whether or not said chamber is gas-tight.

Fig. 2

Fig 1

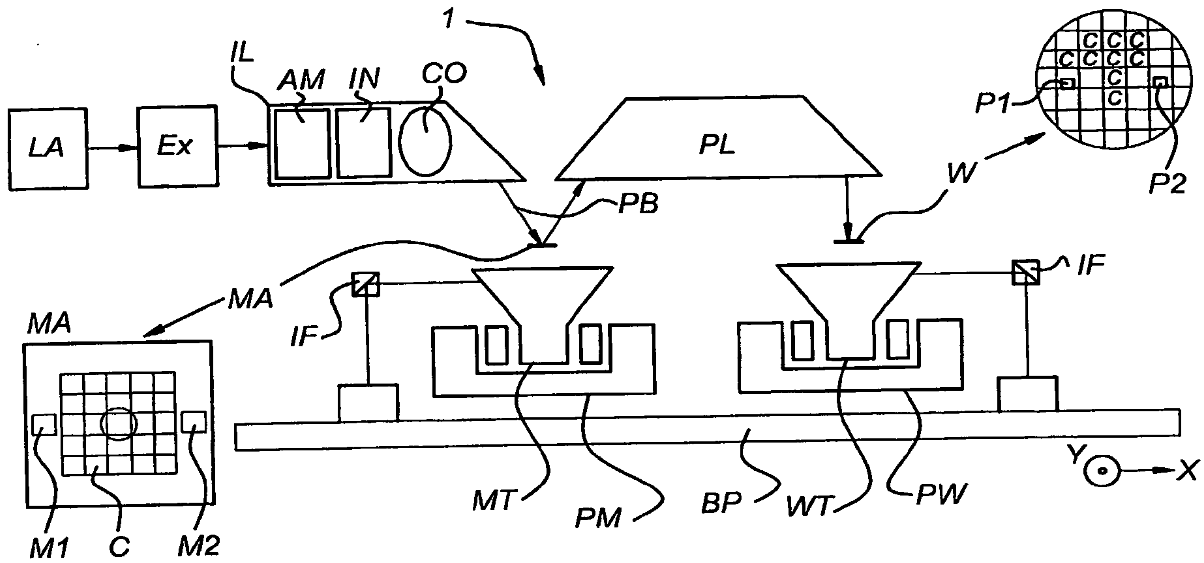

1
IL
AM
IN
CO
LA
Ex
PL
P1
P2
W
PB
IF
MA
MA
IF
M1
C
M2
MT
PM
BP
WT
PW
Y
X

Fig 2

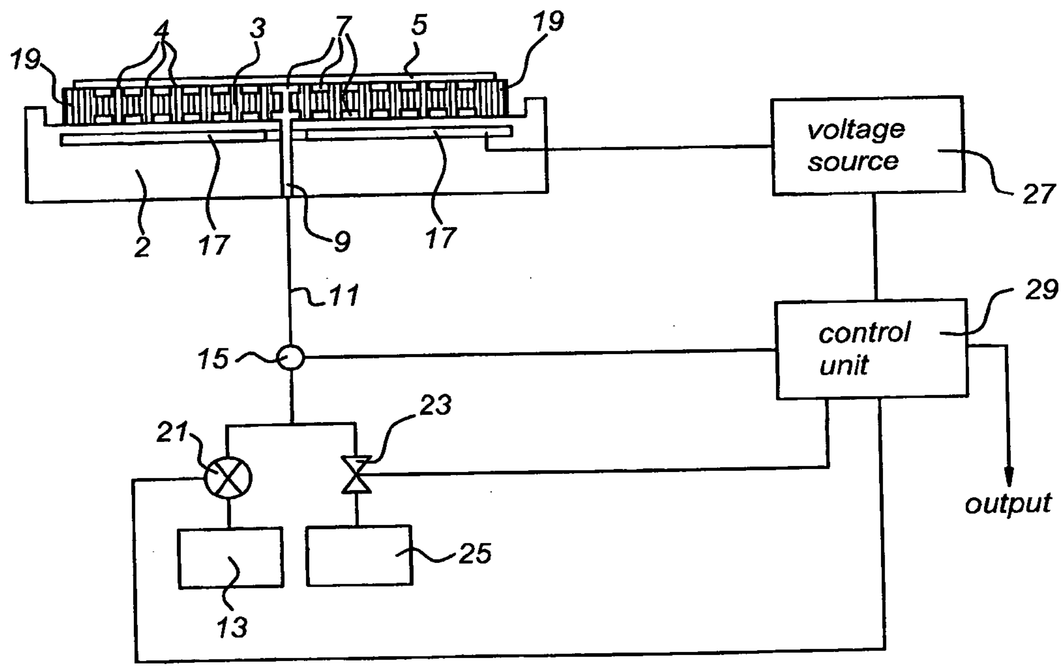

19
4
3
7
5
19
voltage source
27
2
17
9
17
11
15
29
control unit
21
23
output
25
13

Fig 3

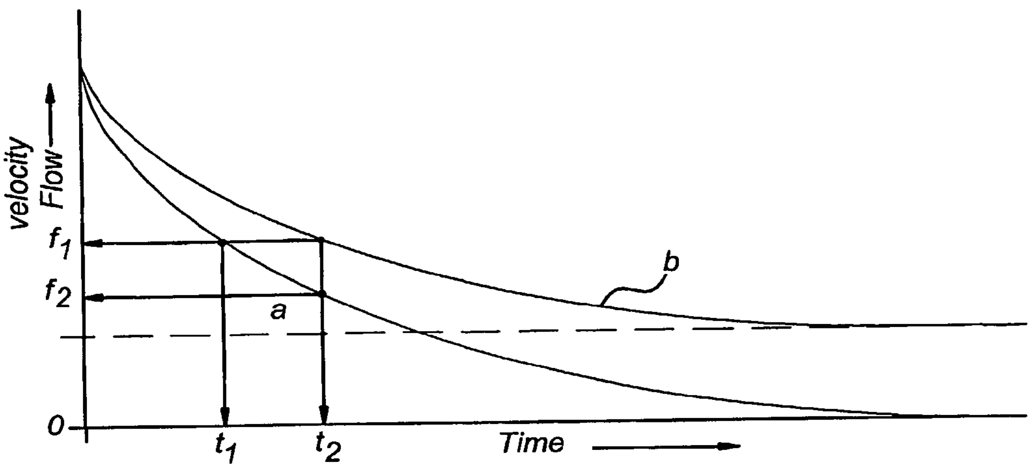

velocity
Flow
f1
f2
a
b
0
t1
t2
Time

Fig 4

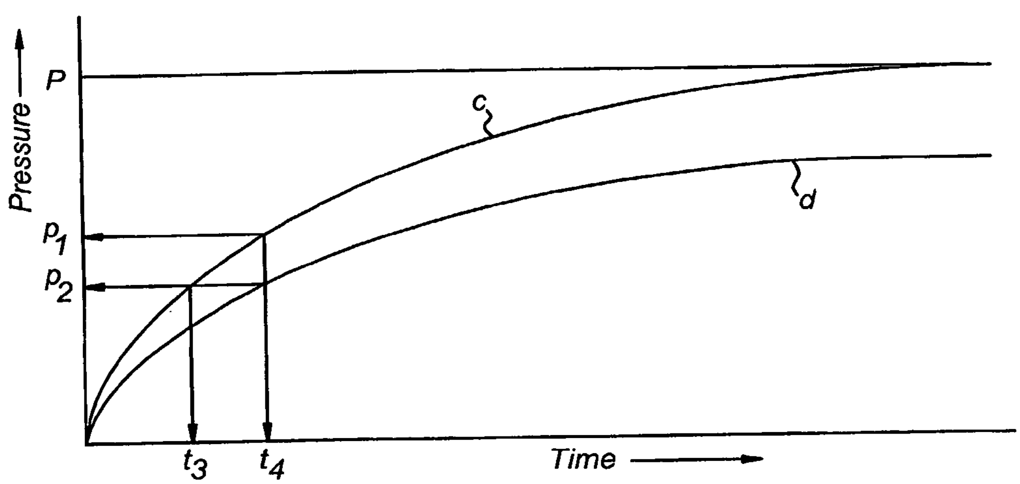
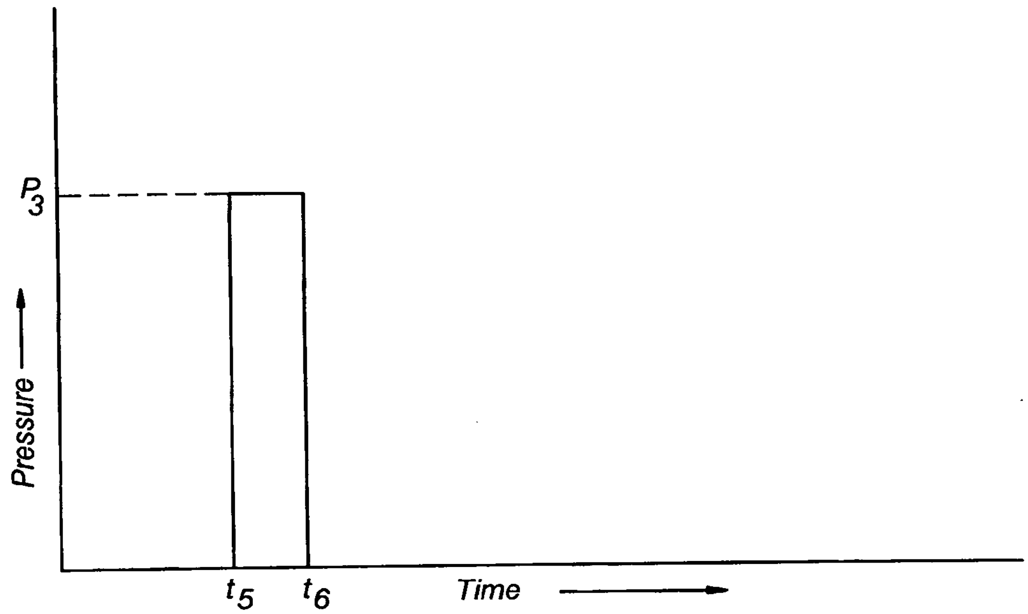

Pressure
P
c
d
p1
p2
t3
t4
Time

Fig 5



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